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Design and Implementation of Broadband Services for Small Scale Organization

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Abstract: ***Nodes are building blocks of telecommunication network which are interconnected by telecommunication links for exchanging messages and data. Broadband Integrated Services Digital Network commonly called as Broadband ISDN or B-ISDN is a high-speed telecommunication network that carry data, voice and video simultaneously over a single channel. It provides interactive services where there is bidirectional flow of information between one or more subscribers and a service provider or distributive services with unidirectional information flow between service provider and subscriber. Speed of B-ISDN normally ranges from 2 Mbps to 1 Gbps and transmission very much relates to Asynchronous Transfer Mode. To design B-ISDN services for small scale organization, resource management and organization requirements play an important role. This paper provides a design of network model and implementation of broadband services for a small-scale organization by considering advance technology requirements, the challenges faced during the implementation and total estimation of budget for entire implementation.***

Keywords: Broadband, Network, Telecommunication

I. INTRODUCTION

Broadband services usually refer to the high-speed internet access which is faster than the traditional dial-up services. In the early days, the telecommunication industry believed that digital services followed same pattern as of voice services in the public switched telephone network. So,they came up with end-to-end circuit switched network that uses high-speed packet switching services called B-ISDN services. The key technology developments for B-ISDN include optical fiber transmission system which provide lowcost and high data rate transmission channels for subscribers,microelectric circuits that provide high-speed, low-cost building blocks for switching, transmission and high-qualityvideo monitors and cameras with efficient production qualityat minimum cost.

B-ISDN services work on the underlying principle of asynchronous transfer mode (ATM) whose major objective is to transport and route voice, data and video. It supplies thenecessary transmission facility using the underlying digital format provided by ATM.

B-ISDN is an extension of ISDN as it pocess both narrowband and broadband capability. The major objective of B-ISDN is to achieve complete integration of services ranging from low-bit-rate burst signals to high-bit-rate continuous real-time signals. Fiber optic cables are used for all the transmission services.

II. LITERATURE SURVEY

In [1], the author discusses about using power line as a local loop in communication for a wide range of customer services in low voltage distribution network. When local loop is integrated in the B-ISDN network, it provides apotential of integrating customer homes into wide area network (WAN) architecture. To evaluate the quality of service provided by B-ISDN, it is very important to formulate a mathematical model which includes parameters like topology, input traffic and routing. [2] presents a mathematical model of routing in B-ISDN with the technology of ATM.

In [3], the author discusses about the routing protocols which play an important in discovering and maintaining the routes in network to provide the services required. If the protocols used are consuming less energy, then the lifetime of the network will be increased which is an added advantage. Secure data transmission is a major challenge in a network. All security mechanisms don't bind well in all the networks because of limited memory resources and energy constraints. Author in [4] proposes a threshold cryptography based key management mechanism to protect the network from intruders. While designing any network, the major quality of service (QoS) parameters that has to be considered are throughput and fairness. Both these parameters should be maximum for any network or system that is designed. So, in [5] the author discusses scheduling algorithms that can be used in the network to increase the throughput and fairness.

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III. RESOURCE MANAGEMENT AND REQUIREMENTS

Resource management is very much essential for setting up an efficient business model for any small-scale organization or an industry. Some of the major resourcemanagement considerations while setting up a business model are described here.

Determining bandwidth requirement based on type of data that has to be transmitted and number of users using the network simultaneously. Evaluating the existing network infrastructure, examining the current hardware and software requirements and determining the need for upgrades and newequipment. Using robust security protocols to protect the network and data from cyber threats which includesimplementing firewalls, encryption and access controltechniques. Backup systems should be kept in place in case of network failure which includes backup servers, power supplies and connectivity options. An organization will have a potential growth of users. So, it is very much important to consider scalability of network model to accommodate additional data traffic and users. Planning a budget to implement and maintain the network which include costs forhardware, software and security measures. Planning the staffing requirements which includes network administrators, security specialists and technical support personnel. The advanced technology requirements to implement broadband services for 100 employees are high-speed broadband internet connection with minimum 100 Mbps download and 50 Mbps upload speed. Robust network infrastructure which includes high-quality routers, switches and cabling to support broadband service. Wireless Access Points to provide wireless connectivity to mobile devices within the organization. Robust firewall and security solutions that are needed to protect the network from cyber-attacks. Network management software which is required to monitor and manage the network. Voice over Internet Protocol telephone system which is required to provide reliable communication channels. Cloud services required for data storage, collaboration and other cloud-based applications.

IV. METHODOLOGY AND ITS IMPLEMENTATION

Enterprise network lays down the foundation for any industry or small-scale organization. It allows effective and profitable communication of business information with the employees and different departments in an organization. Network equipments used to build the network should provide quality of service and consume less energy. Though the same equipments are used to build the network, theperformance of network varies from one location to other because of environmental factors.

Consider a secured IT network which is used in an organization for secure communication and sharing of data, files and resources within the organization. This network avoids unauthorized access into the network by blocking unauthorized users. A logical network topology has been implemented where each routers have been safe guarded with passwords to access them by the user. The network topology implemented connects different departments of a small-scale organization in one location to different locationinto a single network. Routers have been implemented in such a way that each of them should select efficient path for communication so that the data or the information is exchanged in a fast and secure manner. Fig 1 describes the network topology that has been implemented to provide broadband services in a small-scale organization. The network topology has 5 routers. There is one main router in Delhi (Router 1) which is connected to Nirman Vihar router (router 2) and Vaishali router (Router 3). The router 3 is then connected to Ghaziabad router (router4) and Dwarka router (Router 5). The headquarter of the company is situated in Delhi and its router is passwordprotected. Other offices of the company are situated in Dwarka, Nirman Vihar, Ghaziabad and Vaishali. Cables are used to connect routers with switches and switches with personal computers (PCs). PCs are connected to the networkthrough the wireless routers. Serial data terminal equipment (DTE) is used to connect all the routers together.

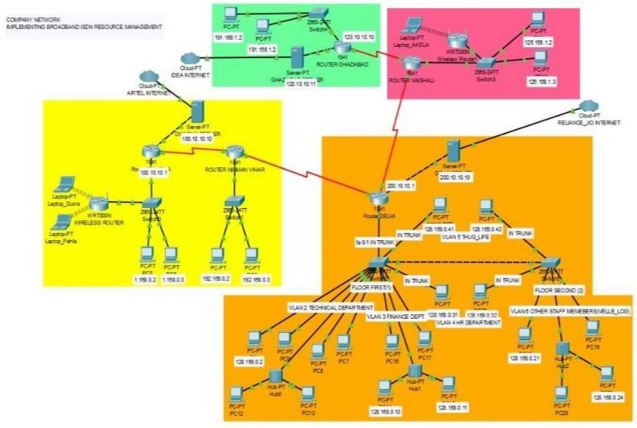


Fig 1: Network topology

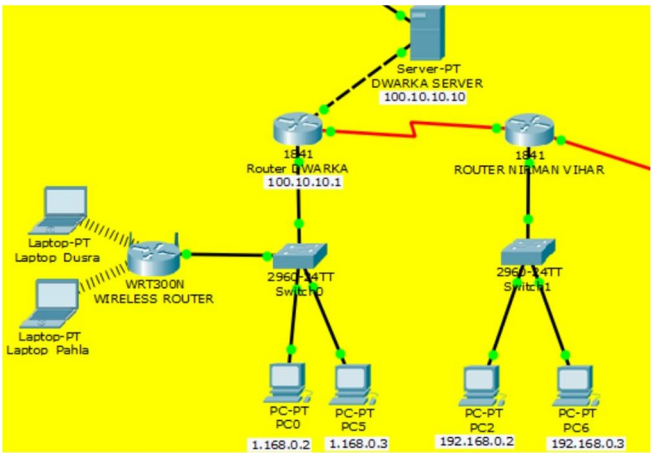


Fig 2: Dwarka and Nirman Vihar router

Fig 2 describes Dwarka and Nirman Vihar router which are connected to each other with the help of serial DTE. Further the routers are connected to switches and end devicesPCs are connected to switches.

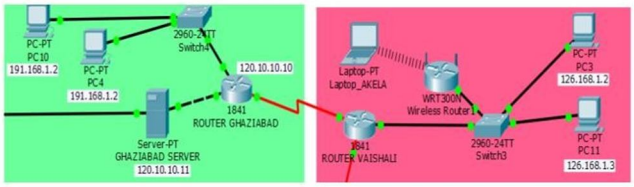


Fig 3: Ghaziabad and Vaishali router

Fig 3 describes the Ghaziabad and Vaishali router connected to each other using serial DTE. Routers are connected to switches and end devices are connected to switches in each of the routers. In the network having Vaishali router, another wireless router is connected to the switch which is used to connect end devices like laptops connect to the network through wireless medium for situations like employees opting for remote work. The other end devices like personal computers are used by the employees working from office.

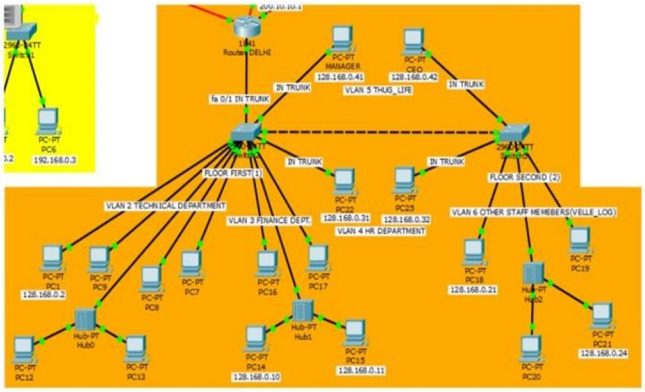
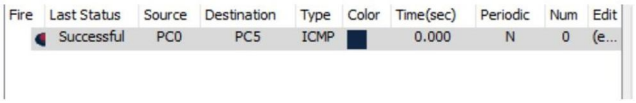


Fig 4: Delhi router

Fig 4 describes the Delhi router which is where headquarter of the company is situated. It consists of different departments like HR department, technical department, Finance department, IT department, facilities department. CEO in the headquarters and the HR departmentrepresentatives are in trunk in the network so that they can easily communicate and share files in the network. Security feature is added in the network through virtual local area network (VLAN) which enables data in one department is not accessible to the other department.

V. RESULTS

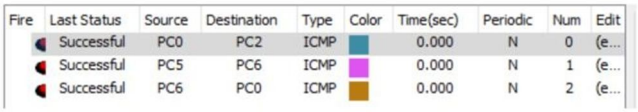
The network topology implemented was tested by sharing data within the department, between different departments and between different branch and main office. The following results are obtained.



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	Successful	PC0	PC5	ICMP		0.000	N	0	(e...

Fig 5: Communication in the same network

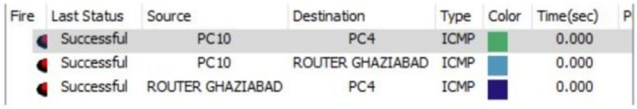
Fig 5 describes the result of communication which was established between two computers namely PC0 and PC5 in the same network of Dwarka router as shown in Fig 2.



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	Successful	PC0	PC2	ICMP		0.000	N	0	(e...
	Successful	PC5	PC6	ICMP		0.000	N	1	(e...
	Successful	PC6	PC0	ICMP		0.000	N	2	(e...

Fig 6: Communication in different network

Fig 6 describes the result of communication which was established between two computers namely PC0 and PC2, PC5 and PC6, PC6 and PC0 in the different network of Dwarka router and Nirman Vihar router as shown in Fig 2.

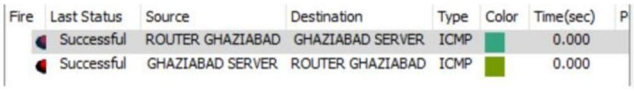


Fire	Last Status	Source	Destination	Type	Color	Time(sec)	P
	Successful	PC10	PC4	ICMP		0.000	
	Successful	PC10	ROUTER GHAZIABAD	ICMP		0.000	
	Successful	ROUTER GHAZIABAD	PC4	ICMP		0.000	

Fig 7: Communication between PC and router

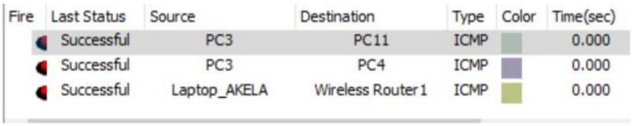
Fig 7 describes the result of communication which was established between two computer and a router and vice versa in a network of Ghaziabad router as shown in Fig 3.

Fig 8 describes the result of communication which was established between router and server and vice versa in a network of Ghaziabad router as shown in Fig 3.



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	P
	Successful	ROUTER GHAZIABAD	GHAZIABAD SERVER	ICMP		0.000	
	Successful	GHAZIABAD SERVER	ROUTER GHAZIABAD	ICMP		0.000	

Fig 8: Communication between router and server



Fire	Last Status	Source	Destination	Type	Color	Time(sec)
	Successful	PC3	PC11	ICMP		0.000
	Successful	PC3	PC4	ICMP		0.000
	Successful	Laptop_AKELA	Wireless Router1	ICMP		0.000

Fig 9: Communication between different network and laptopwith wireless router

Fig 9 describes communication between computer in one network of Vaishali router with the computer in other network of the Ghaziabad router. It also describes the communication between laptop and the wireless router as shown in Fig 3.

Fire	Last Status	Source	Destination	Type	Color	Time(sec)
	Successful	PC1	PC9	ICMP		0.000
	Failed	PC7	PC14	ICMP		0.000
	Successful	PC22	PC25	ICMP		0.000

Fig 10: Communication within the same VLAN

Fig 10 describes the communication between the computers which belong to the same VLAN is successful but the communication between computers which belong to different VLAN is unsuccessful in the network shown in Fig 4 and this satisfies the security mechanism implemented in the network topology.

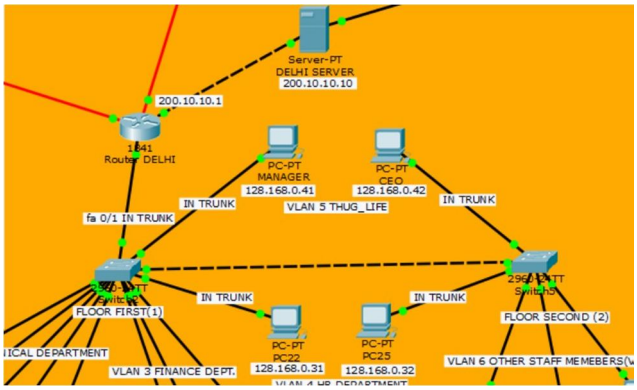


Fig 11: Network topology consisting of manager and CEO

Fire	Last Status	Source	Destination	Type	Color	Time(sec)
	Successful	MANAGER	CEO	ICMP		0.000
	Successful	MANAGER	PC25	ICMP		0.000
	Successful	CEO	PC22	ICMP		0.000

Fig 12: Communication between manager and CEO

Fig 12 describes the result of communication between manager and CEO, manager and computer (employee) and CEO and computer (employee) which has been successful asdescribed in the Fig 11.

VI. CONCLUSION

The network topology is implemented for secure communication of data and information and to provide broadband services for a small-scale organization. The estimated budget for implementing broadband services in a small-scale organization consisting 100 employees can be around 5 to 8 lakhs for the initial implementation which includes the cost of equipment, installation and configuration. This cost may vary depending on various factors like existing infrastructure, the required upgrades and cost of hardware and software. The maintenance cost can vary somewhere around 1 to 2 lakhs which includes fault identification, repair and replacement. While considering the budget for implementing broadband servicesin any small-scale organization, the cost of technical expertise, security solutions and cloud services should also be considered.

While implementing the network topology, there are many challenges that come across. Some of the major challenges that are faced are limited budget as implementingbroadband services can be pretty much expensive and many of the small-scale organization may not have that much budget. Infrastructure upgrades are always required to support the broadband services. When the number of employees or the users of service increases in an organization, there is severe chances of bandwidth congestion which leads to slow network speeds. To safe- guard the network from various cyber attacks and data breaches which are very common in these days, a robust security solution is always required to protect the network. Itis very important for an organization to hire technical experts for managing the network and address the technical issues that may arise in the network.

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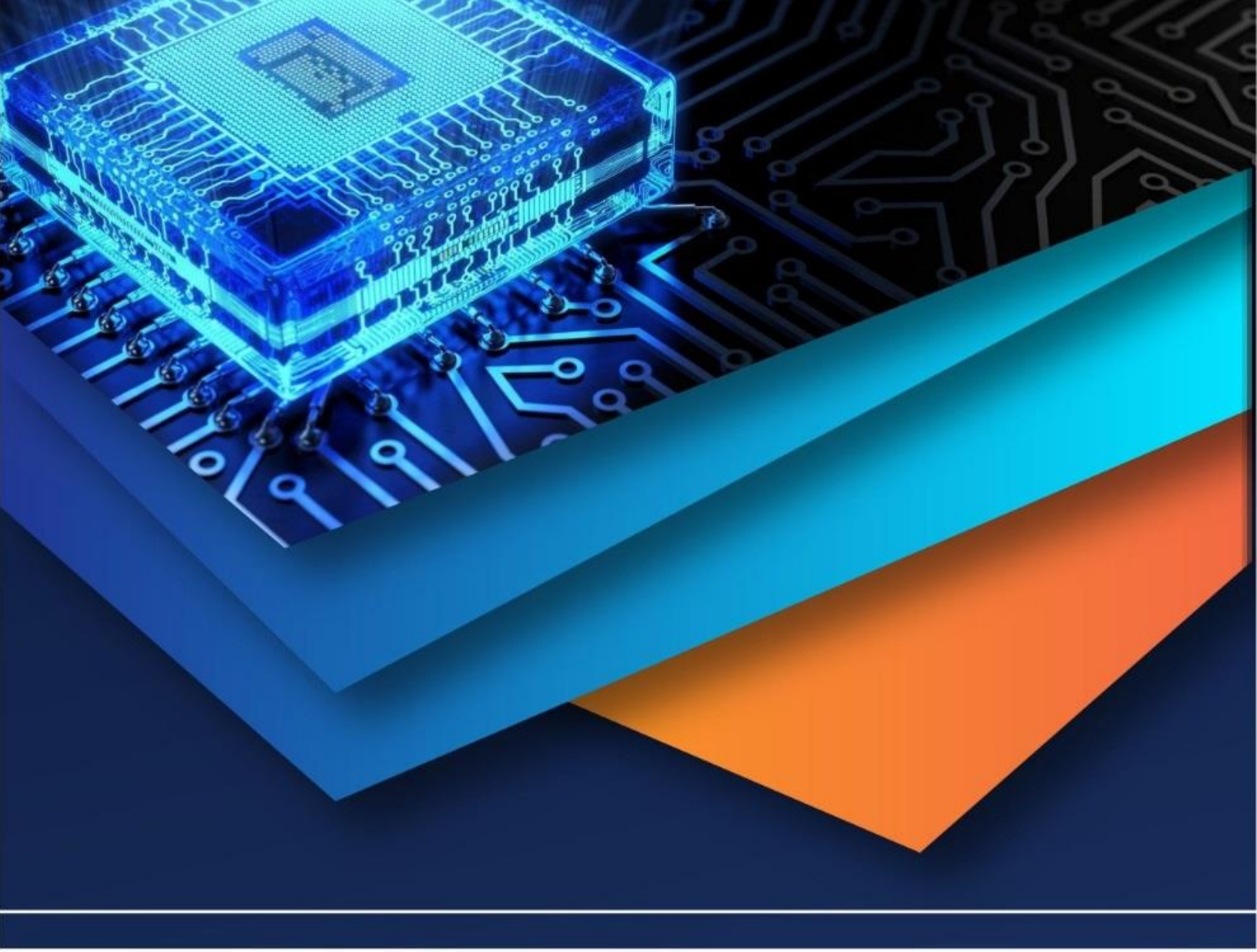

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